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Parental psychological control and adolescent smartphone addiction: roles of reactance and resilience

Qiangqiang Li[1] and Zixiao Liu[2*]

Abstract

Background Problematic smartphone use is a prevalent issue addressed in this study. The research delves into factors associated with problematic smartphone use, employing the self-determination theory. Specifically, the study analyzes the relationship between parental psychological control and problematic smartphone use and investigates psychological reactance as a mediating factor. Moreover, psychological resilience is considered a moderating factor in the relationship between parental psychological control and problematic smartphone use, based on the diathesis-stress model and cognitive model of resilience.

Methods A total of 1300 ($M = 14.22$, $SD = 1.29$) Chinese adolescents were surveyed in a cross-sectional study. They completed self-report questionnaires including the Parental Psychological Control Questionnaire, the Smartphone Addiction Scale, the Psychological Resistance Scale, and the Adolescent Resilience Scale. A moderated mediation model was examined to test predictions.

Results Correlation analysis reveals a positive correlation between parental psychological control, psychological reactance, and problematic smartphone use, and a negative correlation with psychological resilience. Moderation mediation analysis demonstrates that psychological resilience diminishes the direct association between parental psychological control, psychological reactance, and problematic smartphone use, thereby mitigating their relationship.

Conclusions The findings support the moderation mediation model, indicating that psychological resilience plays a crucial role in safeguarding adolescents from the adverse effects of problematic smartphone use induced by parental psychological control.

Keywords Parental psychological control, Problematic smartphone use, Psychological reactance, Psychological resilience

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Introduction

Problematic smartphone use is defined as an inability to regulate one's use of the mobile phone, which eventually involves negative consequences in daily life [1]. Problematic smartphone use is now defined as maladaptive psychological symptoms caused by excessive smartphone use [2]. This leads to addictive symptoms marked by distress or functional impairment, as well as non-addictive symptoms characterized by escapism [3]. Some studies indicate that the prevalence of problematic smartphone use among Chinese children and adolescents ranges from 23.5 to 40.4% [4, 5]. Studies have shown that smartphone addiction is related to difficulty in performing daily activities, positive anticipation, withdrawal, cyberspace-oriented relationship, overuse, and tolerance [6], preoccupation, inability to control craving, disregard of harmful consequences, productivity loss, and feeling anxious and lost [7, 8]. Due to the widespread occurrence and negative effects of problematic smartphone use, it is essential to investigate the mechanisms behind its occurrence in Chinese adolescents for effective prevention and intervention.

For a long time, factors related to the family have been a focus of attention because these factors have a significant impact on the growth of adolescents, who are at higher risk [9]. For example, problematic social media use was one of the predictors of low family functioning [10]. Yıldırım and colleagues (2023) highlights the link between problematic social media use and poor family relationships, which, in turn, may lead to psychological adjustment problems [7]. From a developmental perspective, family-related factors have a greater impact on the problematic smartphone use of adolescents than adults [11]. Previous researches have revealed protective and risk factors of parents on problematic smartphone use [12, 13]. For instance, parental control is identified as a risk factor. However, some research has shown that specific types of parental control, like parental monitoring, restrictions, positive mediation, and supervision, are inversely associated with problematic smartphone use [14, 15]. Different dimensions of parental control (including psychological control and behavioral control) can explain this inconsistency. Few studies have explored how parental psychological control (PPC, it is defined as a highly insidious type of control that potentially inhibits or violates psychological development through manipulation and abuse of the parent-child bond, negative emotional expressions, criticism, and excessive personal control [16].) relates to problematic smartphone use. In China's collectivist culture, parents tend to exert more psychological control than some Western nations, like the United States, due to the belief that "my child is my report card." [17]. Therefore, it is necessary to explore the adverse consequences of parental psychological control

on Chinese adolescent behavior. Some studies have found that parental psychological control has adverse effects on real-life problematic behaviors (such as risky online behaviors) [18]. Past studies have not often explored parental psychological control as a separate concept linked to smartphone use. For example, a small number of studies suggest that parental psychological control can indirectly cause their problematic smartphone use by affecting social anxiety [19]. However, there are still gaps regarding how parental psychological control can increase the risk of problematic smartphone use. Specifically, aside from social anxiety, what other pathways (such as psychological reactance) might parental psychological control influence in relation to adolescents' problematic smartphone use, and whether the effects of these different pathways are moderated by other variables (such as psychological resilience). This study seeks to fill these gaps by examining the correlation between parental psychological control and problematic smartphone use, along with its underlying mechanisms.

Parental psychological control, as per the self-determination theory (SDT; Deci & Ryan, 2008) [20], inhibits the fulfillment of basic psychological needs like autonomy, competence, and relatedness. This, in turn, enhances the likelihood of negative behaviors, such as problematic smartphone use. The imposition of specific ways of thinking and behaving on children by parents, along with parents' conditional regard, undermines children's autonomy and relatedness needs [21]. Consequently, children may exhibit psychological reactance (PRt, it is defined as when something threatens or removes people's freedom, they are motivated to restore it [22].), leading to an increase in problematic smartphone use. Psychological resilience (PRl, it is defined as the capacity for recovery and "bouncing back" from adversity or significant sources of stress [23].), according to the diathesis-stress model [24] and cognitive model of resilience [25], could mitigate maladaptive coping strategies, like parental psychological control, and associated behavioral outcomes when dealing with stress. Hence, we anticipate that psychological resilience could lessen the direct and indirect links between parental psychological control and problematic smartphone use. Therefore, drawing from SDT and two resilience models, this research investigates the correlation between parental psychological control and problematic smartphone use, the mediating role of psychological reactance, and the moderating roles of psychological resilience in this association.

The relationship between parental psychological control and problematic smartphone use

Parental psychological control involves intrusive and manipulative parenting behaviors that are maladaptive. It includes parents trying to control their children by

fostering dependence, using psychological tactics, and inhibiting individualized development [21, 26]. According to Çiçek et al. (2021), parental attitudes (authoritarian, One of the main manifestations is the parental psychological control) is assumed to have effects on internet, social media, and smartphone usage level of young adults [27]. Based on SDT [20], parental psychological control, parental criticism, and contingently conditional parental regard hinder children's autonomy, competence, and relatedness needs. This impairs children's social adaptation and contributes to externalizing problems [21], such as problematic internet use. Multiple studies corroborate this perspective. For instance, parental psychological control has been correlated with internet gaming addiction [28], a notable risk factor for problematic smartphone use [7]. Furthermore, the authoritarian parenting style of parents, marked by punitive and severe methods, is strongly linked to excessive smartphone use [29]. Hence, we posit the hypothesis H1: there is a positive correlation between parental psychological control and problematic smartphone use.

Psychological reactance as a mediator
According to SDT [20], psychological reactance could play a crucial role in the relationship between parental psychological control and problematic smartphone use. This demonstrates the importance of maintaining psychological freedom when individuals feel threatened [30]. Studies have shown a positive link between parental psychological control and psychological reactance [31]. The restrictiveness of psychological control tends to evoke greater psychological reactance compared to behavioral control [32]. Moreover, similar findings in the field of administration similarly support our view. For instance, Haider et al. (2023)discusses the balance between control and autonomy in leadership, which could provide insight into how adolescents may react negatively to excessive parental control, That is, adolescents faced with high levels of parental psychological control can severely undermine their autonomy, And this may cause a strong psychological rebellion [33].

Although lacking empirical evidence, predicting a positive correlation between psychological reactance and problematic smartphone use is logically sound. Psychological reactance theory suggests that poor parent-child relationships could obstruct individuals' behavioral and psychological freedom, resulting in increased reactance and initiating an "uncivilized motivational state." On the one hand, Children may find it challenging to reclaim their freedom within poor parent-child relationships, causing problematic and undesirable behaviors to seem more attractive. Therefore, poorer parent-child relationships are linked to increased smartphone use. On the other hand, excessive psychological control may lead to

stress and psychological reactance in adolescents. Sohail and Rehman (2015) examine stress from external pressures can lead to resistance, a dynamic that could be analogous to adolescent behavior in response to parental control [34]. These connections have been supported by indirect evidence. People with high psychological reactance tend to use mobile media more often [35], leading to more problematic smartphone use [36]. Moreover, individuals with high psychological reactance exhibit lower self-control [37], which may result in adolescents engaging in problematic smartphone use [38, 39]. In addition, studies from the management field suggest that individuals will increase their reactance when exposed to abusive supervision [40]. Consequently, adolescents with stronger psychological reactance are prone to experiencing issues with smartphone use.

Parental psychological control is positively linked to psychological reactance. It's also positively linked to problematic smartphone use. Psychological reactance can act as a mediator between parental psychological control and problematic smartphone use. A systematic review indirectly supports this idea, suggesting that psychological reactance can explain the relationship between parental psychological control and externalizing problems, including problematic internet use [21]. However, this hypothesis has not been empirically validated yet. This study aims to proposes the hypothesis H2 that psychological reactance mediates the connection between parental psychological control and problematic smartphone use.

Psychological resilience as a moderator
Psychological resilience is the capacity to handle challenges and bounce back from negative surroundings [41]. The diathesis-stress [24] model suggests that psychological resilience can shield teenagers from harmful impacts of negative developmental occurrences or stress on mental health growth. To date, studies have shown that psychological resources such as resilience can significantly mitigate the levels of fear and psychological distress [8, 42]. Hence, we expect that psychological resilience could mitigate the link between parental psychological control and problematic smartphone use. Previous studies provide indirect backing for this idea. For instance, psychological resilience has the ability to mitigate the adverse impacts of parental death, rejection, and divorce on educational achievement [43]. Furthermore, individuals with low psychological resilience may face a higher likelihood of depression when exposed to adverse childhood experiences like neglect, abuse, and family dysfunction. This is supported by Tehseen et al. (2024) [44], the study highlights the importance of individual resilience in navigating challenging environments, which could be applied to the context of adolescent smartphone use. This study

supports our argument about the moderating role of resilience in adolescents' responses to parental psychological control. Thus, psychological resilience could act as a buffer in the relationship between parental psychological control and problematic smartphone use. Consequently, we hypothesize that psychological resilience moderates the connection between parental psychological control and problematic smartphone use (H3).

According to the cognitive model of resilience, individuals with high psychological resilience will enhance the flexibility of their cognitive processes and emotional information processing, promoting effective self-regulation when coping with stress that triggers problematic behaviors like excessive smartphone use [45]. Furthermore, psychological resilience is expected to moderate the relationship between psychological reactance and problematic smartphone use, based on the deduction that adaptive cognitive processing adjusts to assist adolescents in developing adaptive behaviors. The buffering effect of psychological resilience on the association between psychological reactance and smartphone use is supported by indirect evidence indicating that adolescents with high psychological resilience demonstrate better mindfulness and cognitive reappraisal skills [46], which in turn can mitigate the negative impact of psychological reactance, thereby enhancing mental health. Consequently, it is hypothesized that the mediating effect of psychological reactance will be alleviated by psychological resilience. This leads to the proposed hypothesis: H4 psychological resilience moderates the relationship between psychological reactance and problematic smartphone use.

The current study
This study aimed to investigate: (a) the link between parental psychological control and problematic smartphone use, (b) the interconnections among parental psychological control, problematic smartphone use, and psychological reactance, and (c) the assessment of how psychological resilience influences the direct and indirect connections of parental psychological control and problematic smartphone use. Refer to "Figure 1. The proposed moderated mediation model." for more detail.

Methods
Participants
Convenience sampling was employed to select participants. Based on a collaborative project between the corresponding author's school and the Education Department of Hunan Province, China. This study received approval from the local school ethics committee and obtained informed consent from school administrators, teachers, parents, and adolescents. To further safeguard the rights of participants, we emphasized in the instructions that, under the condition of anonymity, participants are free to withdraw from the test at any time if they feel any discomfort during the process. The eligibility criteria for participants were: (a) aged < 18 years, (b) having reading ability, or able to communicate with investigators without difficulty, (c) completing all of the questionnaire. A total of 1398 students participated in the current study, and 98 (7.4%) were removed because they didn't complete all the questionnaires. The remaining 1300 (620 females, 47.7%) Chinese adolescents completed all anonymous self-report questionnaires voluntarily. The age range of the participants was 12 to 17 years with a mean age of 14.22 years ($SD = 1.29$). The participants consisted
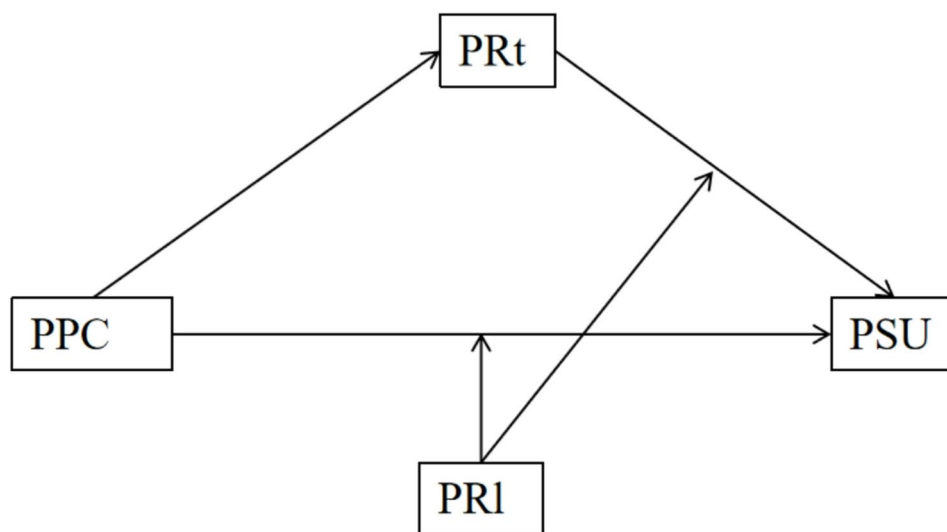

Fig. 1 The proposed moderated mediation model
PPC: parental psychological control; PRt: psychological reactance; PRl: psychological resilience; PSU: problematic smartphone use

of 240 being only children and 1060 non-only children, 1002 adolescents from two-parent families and 298 from single-parent families, 402 adolescents from rural areas and 898 from urban areas. All participants were of Han ethnicity and had used a mobile phone or computer for internet access in the past year.

Measures
Parental Psychological Control. The Parental Psychological Control Questionnaire [47] in its Chinese version was used for measurement. A 5-point Likert scale was used to score 36 items (18 items for father's psychological control and 18 items for mother's psychological control). The total score ranges from 36 to 540. A higher average score indicates a stronger perception of PPC in adolescents. The questionnaire demonstrated satisfactory reliability and validity, suitable for evaluating the level of PPC perception in Chinese adolescents [47]. The scale revealed a satisfactory internal consistency in the current sample (Cronbach's $\alpha = 0.93$).

Problematic Smartphone Use. In order to measure PSU, we utilized a brief version of the Smartphone Addiction Scale for Adolescents [48]. It has demonstrated satisfactory reliability and validity among Chinese secondary school students [49]. The tool consists of 10 items, rated on a 6-point Likert scale, ranging from 1 (strongly disagree) to 6 (strongly agree). The total score ranges from 10 to 60, with higher scores indicating problematic smartphone use. In this study, Cronbach's α for this questionnaire was 0.92.

Psychological Reactance. The Hong's Psychological Resistance Scale (HPRS; Hong & Faedda, 1996) [50] was utilized. It demonstrated satisfactory reliability and validity among Chinese high school students [51]. Participants rated each item on a Likert 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The total score ranges from 5 to 25, with higher scores indicating a higher level of psychological reactance. The Cronbach's alpha coefficient of the total scale was 0.89 in this study.

Psychological Resilience. The Chinese Adolescent Resilience Scale (RSCA) developed by Hu and Gan (2008) [52] was used for measurement in Chinese adolescents. It demonstrated satisfactory reliability and validity in Chinese adolescents [53]. The scale consists of 27 items, divided into 5 dimensions, namely goal concentration, emotion regulation, positive perception, family support, and interpersonal assistance. Adolescents rated each item using a Likert 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The total score ranges from 27 to 675. The higher the average score, the higher the resilience. This scale revealed good internal consistency (Cronbach $\alpha = 0.91$) in the current sample.

Common variance test
Common method bias is the artificial covariation between predictor variables and criterion variables due to factors like the data source, measurement environment, project context, and project characteristics. To address this bias and enhance response authenticity, participants were assured anonymity and confidentiality in completing the questionnaire for academic research purposes. Analysis revealed eigenvalues of 16 factors exceeding 1 in total, with the largest factor explaining 24.19% of the variance [54]. As the common method bias was below 40%, the study did not exhibit a significant common method bias effect.

Statistical analyses
Descriptive statistics and correlational analyses were conducted using SPSS 22.0. Missing data were addressed via expectation–maximization (EM) algorithm [55]. Skewness and kurtosis values for parental psychological control, psychological resilience, and problematic smartphone use were within acceptable parameters (i.e., skewness $<|2.0|$ and kurtosis $<|7.0|$ [56]),). However, the distribution of psychological reactance (Skewness = 2.75) exhibited some skew. Consequently, bootstrapping was employed to compute estimators. Bootstrapping offers a method for conducting statistical tests and constructing confidence intervals without relying on the conventional assumption of normality [57]. This approach was utilized to assess and validate the statistical significance of the path coefficients in the present study, irrespective of data distribution. Specifically, the study initially computed descriptive statistics for the variables of interest, followed by an examination of bivariate relationships among these variables. Subsequently, the PROCESS macro (Model 4) was implemented to examine the mediation effect. Finally, the PROCESS macro (Model 15) was used to assess whether psychological resilience moderated the mediation mechanism.

Descriptive statistics and correlation analysis
The independent sample *t*-test shows that males perceive significantly more parental psychological control than females ($t = 2.50$, $p = 0.013$). There were no differences in psychological reactance ($t = -0.51$, $p = 0.40$), problematic smartphone use ($t = 1.72$, $p = 0.08$), and psychological resilience ($t = 0.69$, $p = 0.52$) between males and females. Gender was dummy coded such that 1 = female and 0 = male. Age is positively correlated with psychological reactance ($r = 0.05$, $p = 0.03$), problematic smartphone use ($r = 0.12$, $p < 0.01$), and psychological resilience ($r = 0.09$, $p = 0.03$). Gender and age will be considered as covariates in subsequent analysis. Descriptive statistics and correlation matrices for all study variables are provided in Table 1. Parental psychological control, psychological

Table 1 Descriptive statistics and correlation matrix of all variables

Variables	M	SD	1	2	3	4	5	6
1.Gender	-	-	1					
2.Age	14.22	1.29	-	1				
3.PPC	2.78	0.92	-	0.04	1			
4.PRt	2.99	1.50	-	0.07*	0.43**	1		
5.PRl	4.27	0.63	-	-0.12**	-0.32**	-0.50**	1	
6.PSU	3.20	1.12	-	0.10**	0.32**	0.51**	-0.47**	1

Note. $N = 1300$. $*p < 0.05$, $**p < 0.01$. PPC = Parental psychological control, PRt = Psychological reactance, PRl = Psychological resilience, PSU = Problematic smartphone use

Table 2 Testing the pathways of the mediation model

Predictors	Model 1 (PRt)			Model 2 (PSU)			Model 3 (PSU)		
	b	SE	t	b	SE	t	b	SE	t
Gender	-0.03	0.40	1.01	-0.01	0.53	0.38	-0.02	0.59	-0.81
Age	0.04	0.06	-1.60	0.06	0.08	-2.55	0.07	0.09	3.00*
PPC	0.43	0.01	17.10***	0.12	0.02	4.68**	0.32	0.02	12.07***
PRt				0.46	0.04	17.41***			
R^2	0.19			0.28			0.11		
F	99.33***			124.85***			53.02***		

Note. $N = 1300$. PPC = Parental psychological control, PSU = Problematic smartphone use, PRt = Psychological reactance. $**p < 0.01$. $***p < 0.001$. Each variable is brought into the regression equation after standardized treatment

reactance, and problematic smartphone use are significantly positively correlated and negatively correlated with psychological resilience ($p < 0.01$).

Mediation model test

Table 2 displays the outcomes of the mediation examination. Even when considering gender and age, all paths exhibit significance ($p < 0.001$). The complete impact is 0.22, $p < 0.001$, 95% CI [0.01, 0.18], backing hypothesis 1, indicating parental psychological control is positively linked to problematic smartphone use. Additionally, psychological reactance acts as a mediator in the correlation between parental psychological control and problematic smartphone use, revealing a significant path from parental psychological control to psychological reactance to problematic smartphone use (indirect effect = 0.13, 95% CI [0.10, 0.16]), thereby supporting hypothesis 2. The residual direct effect also holds significance ($b = 0.17$, $p < 0.001$). Thus, psychological reactance partially mediates the connection between parental psychological control and problematic smartphone use. The model explains 36.37% of the variability in problematic smartphone use among Chinese adolescents.

Moderated mediation model test

We expected that psychological resilience would moderate the direct relationships between parental psychological control and problematic smartphone use. Specifically, we tested whether psychological resilience moderated: (1) the relationship between parental psychological control and problematic smartphone use; (2) the relationship between psychological reactance and problematic smartphone use. In each model, we controlled for adolescents' gender and age.

Table 3; Fig. 2 show the results of the moderated mediation analysis in adolescents, while controlling for gender and age. A significant interaction between parental psychological control and psychological resilience on problematic smartphone use was found ($b = -0.10$, $p < 0.001$). This interaction suggests that psychological resilience weakens the positive connection between parental psychological control and problematic smartphone use. The increase in psychological resilience also diminished the mediating effect of psychological reactance. Specifically, when psychological resilience was one standard deviation below the mean, the indirect effect was 0.12 (95% CI [0.06, 0.15]); when it was one standard deviation above the mean, the indirect effect was 0.01 (95% CI [-0.03, 0.05]). These findings support the hypothesis 3 that psychological resilience moderates the direct relationship between parental psychological control and problematic smartphone use.

Secondly, the significant negative interaction of psychological reactance and psychological resilience on problematic smartphone use indicates that psychological resilience attenuates (negatively moderates) the positive correlation between psychological reactance and problematic smartphone use ($b = -0.10$, $p < 0.001$). The increase in psychological resilience even attenuated the mediating effect of psychological reactance, specifically, when psychological resilience = $M - 1SD$, the indirect effect was 0.10 (95% CI [0.01, 0.10]); when psychological resilience = $M + 1SD$, the indirect effect was 0.02 (95% CI [-0.07, 0.11]).

Table 3 Testing the moderated mediation effect model

Predictors	Model 1 (PRt)			Model 2 (PSU)		
	b	SE	t	b	SE	t
Gender	-0.03	0.40	0.16	-0.34	0.52	0.06
Age	0.04	0.06	0.01	-0.10	0.22	0.04
PPC	0.43	0.01	17.00***	0.15	0.09	2.63*
PRt				0.81	0.17	4.68***
PRl				-0.41	0.13	-3.22**
PPC × PRl				-0.19	0.01	-2.28*
PRt × PRl				-0.15	0.01	-2.15*
R^2	0.19			0.34		
F	99.33***			94.03***		

Note. $N = 1300$. PPC = Parental psychological control, PSU = Problematic smartphone use, PRt = Psychological reactance, PRl = Psychological resilience.*$p < 0.05$.
**$p < 0.01$. ***$p < 0.001$. Each variable is brought into the regression equation after standardized treatment
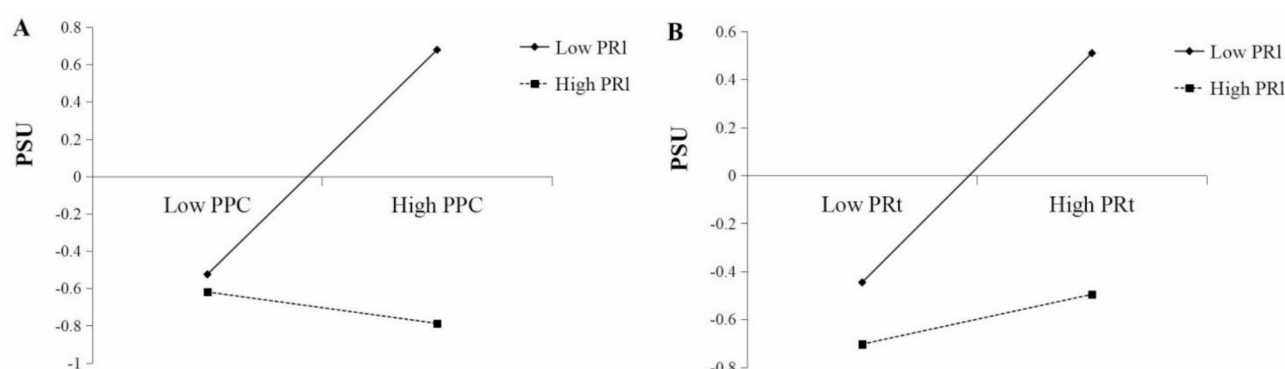
Fig. 2 Simple slope analysis of the moderating effect of PRl
Note: (**A**) PSU as a function of PPC and PRl. (**B**) PSU as a function of PRt and PRl
PPC = Parental psychological control, PSU = Problematic smartphone use, PRt = Psychological reactance, PRl = Psychological resilience

Discussion

Given the high prevalence and adverse consequences of problematic smartphone use, there has been a surge in research examining its risk factors. While the association between parental psychological control and problematic smartphone use among adolescents is well-established, the mechanisms and boundary conditions of this relationship remain less understood. The current study adds to the knowledge about these issues by investigating the direct association between parental psychological control and adolescents' problematic smartphone use, while simultaneously exploring the mediating role of psychological reactance and the moderating role of psychological resilience. Results indicated that parental psychological control was significantly and positively associated with adolescents' problematic smartphone use, even after controlling for age and gender. Psychological reactance mediated the relationship between parental psychological control and problematic smartphone use. Psychological resilience moderated both the association between parental psychological control and problematic smartphone use, and the association between psychological reactance and problematic smartphone use.

Parental psychological control and problematic smartphone use

The model showcasing overall effects reveals that parental psychological control correlates with problematic smartphone use in Chinese adolescents, affirming hypothesis 1. Since parents' attitude and behaviour patterns towards adolescents lay the groundwork for the emergence of unwanted behavioral problems in adolescents in the future [27]. This finding aligns with Self-Determination Theory [20] and is supported by previous studies investigating the link between parental psychological control and various externalizing issues [58]. The mechanisms of emotion regulation and self-control might underlie the connection between emotion regulation and externalizing problems like problematic smartphone use [59]. Additionally, an alternative interpretation suggests that this detrimental parenting practice (parental psychological control) could hinder adolescents' ability to freely express themselves without fear of rejection or abandonment, as well as disrupt their reliance and trust in others, potentially leading to increased online behavioral risks such as smartphone addiction [18]. Notably, these distinct effects might be more prominent in Chinese adolescents, given that Chinese parents tend

to exert more control over their children, guided by the belief that "my child is my report card" [17]. These findings highlight the importance of considering Parent-child relationship when addressing the smartphone addition of adolescents, and intervention should be provided early to prevent or address problems in these relationships.

Mediating role of psychological reactance
The study investigates the impact of parental psychological control on problematic smartphone use, utilizing SDT [20] to examine psychological reactance as a mediator. Results demonstrate that psychological reactance mediates the relationship between parental psychological control and smartphone overuse, confirming hypothesis 2. According to our expectations, psychological reactance acts as a mediator between parental psychological control and problematic smartphone use. This aligns with SDT [20], which proposes that parental psychological control can activate psychological reactance, eventually resulting in problematic smartphone behavior. This conforms to prior studies showing that psychological reactance serves as a mediator between parental control and externalizing or internalizing issues [31]. In essence, in parent-child interactions, parental psychological control may disrupt an individual's sense of behavioral and psychological autonomy, leading to increased reactivity, heightened defiance, and inclination towards inappropriate behaviors, such as problematic smartphone use.

Individual differences are significant, with parental psychological control being linked to psychological reactance, as shown in previous studies [31, 32]. This may occur because parental psychological control constrains adolescents' autonomy, leading to psychological reactance and the subsequent quest for autonomy [60]. Furthermore, psychological reactance is associated with problematic smartphone use, predicting internalizing and externalizing problems [31, 61], potentially due to negative cognition in adolescents [31], which might result in excessive internet and smartphone use. Therefore, psychological reactance could be a forewarning of problematic smartphone behaviors, supported by theoretical and empirical evidence endorsing its mediating role.

Moderating role of psychological resilience
Additionally, the research incorporates the diathesis-stress model [24] to analyze the moderating role of psychological resilience. The findings reveal that high psychological resilience mitigates the link between parental psychological control and smartphone misuse, providing strong support for the moderation mediation model and hypotheses 3–4. The proposed moderated mediation model received empirical support, revealing that psychological resilience played a moderating role in the direct and indirect relationships between parental

psychological control and problematic smartphone use through psychological reactance, thereby confirming hypotheses 3–4. This result suggests that resilient adolescents may tend to experience less smartphone addiction. They may be better to deal with the symptoms of smartphone addiction. Previous studies have demonstrated that resilience was negatively associated with anxiety and stress [8, 62].

Firstly, research findings reveal a significant relationship between psychological resilience and the impact of parental psychological control on problematic smartphone use among adolescents. This suggests that psychological resilience can help adolescents cope with parental psychological control and effectively adapt and promote their development [63]. Prior studies have shown that psychological resilience plays a vital role in mitigating the effects of parental influences on adverse outcomes [43]. Adolescents with high psychological resilience demonstrate the ability to effectively manage stress and trauma, thereby reducing the negative consequences associated with problematic smartphone use linked to parental control [64]. This study contributes to the existing literature by highlighting the protective function of psychological resilience in aiding adolescents exposed to parental psychological control in avoiding issues related to problematic smartphone use.

Secondly, the analysis of adjustments also shows that strong psychological resilience can either weaken or completely disrupt the direct connection between psychological reactance and problematic smartphone use. This disruption also affects the mediating role of psychological reactance, endorsing the cognitive resilience model [25]. According to this theoretical framework, the outcome can be clarified by the efficient regulation of emotions in teenagers with high levels of psychological resilience when exhibiting undesirable actions. Individuals with heightened psychological resilience tend to employ effective strategies for regulating their emotions [65], which assists them in efficiently managing the adverse emotions induced by psychological reactance [31]. Moreover, this aids in decreasing the likelihood of problematic smartphone use among adolescents [66]. Resilience seems to be important in mitigating the negative impact of fear of psychological reactance on smartphone addiction among adolescents.

The moderated mediation model in the hypothetical scenario exhibited superior predictive capability compared to the standalone mediation model. The current research findings suggest that the relationships between parental psychological control and problematic smartphone use through psychological reactance were not statistically significant for psychologically resilient adolescents.

Practical implications and future directions

This study suggests that a strong parental psychological control may be a risk factor for problematic smartphone use among adolescents. The current study enriches the knowledge and literature on the mechanisms connecting the relationship between parental psychological control and problematic smartphone use. To some extent, these findings have enriched the application of the social-ecological conceptual framework of problematic smartphone use to explain the roles of family functions in problematic smartphone use. Specifically, parents exerting excessive psychological control over their adolescent children could potentially lead to an increased risk of problematic smartphone use. This finding underscores the importance for parents to reconsider and decrease their level of psychological control in order to mitigate such risks. In Chinese society, parental behavior is often influenced by the belief that their children's accomplishments reflect their own self-esteem, leading to heightened psychological control compared to Western parenting practices [17]. To address this issue, it is crucial to empower Chinese parents, enhance their self-worth, and promote a greater understanding of their children's need for autonomy, ultimately reducing excessive psychological control. The study also identifies two key intervention strategies to curb the risk of problematic smartphone use among adolescents facing high levels of parental psychological control. Firstly, enhancing psychological resilience through interventions like mindfulness programs and cognitive reappraisal training can be effective. In the Chinese cultural context, promoting dialectical thinking, Confucian values, and collectivism can enhance adolescents' ability to cope with challenges [52]. Secondly, teaching emotional regulation techniques and promoting rational thinking is vital in alleviating negative psychological reactance. Additionally, given the cultural emphasis on filial piety and respect for elders in China, creating a supportive environment for adolescents to openly discuss their views and values can be beneficial [67]. By fostering emotional expression and independence in Chinese adolescents, parents and educators can effectively reduce psychological reactance and encourage a healthier relationship dynamic. Finally, combined with the current findings, in order to reduce the problematic smartphone use of teenagers, parents should timely adjust their parenting strategies, and communicating with teenagers in a more open and democratic parenting style may help teenagers out of the problem of smartphone addiction.

Although theoretically supporting the proposed intervention measures, this study still has four limitations. Firstly, the missing collection of longitudinal data cannot reveal the causal relationship between variables. In the future, longitudinal surveys or experimental studies can be used to explain the causal relationship between parental psychological control and problematic smartphone use. This could help us understand whether the effects of parenting style on adolescent smartphone addiction problems are duration effects. Secondly, the self-report measurement method used in this study for adolescents may be influenced by participants' individual characteristics. In future research, the use of multiple informants (mothers, fathers, and children) and objective parental psychological control measurement methods (observation of parent-child interactions, interviews) would help to avoid subjective interference and clarify how children perceive the actual parenting behaviors of parents. Lastly, our sample only includes Chinese mainland adolescents. Therefore, the generalizability of the research results is limited. In fact, the influence of parental psychological control on Chinese adolescents may be more apparent, as Chinese parents are more controlling than Western parents [17]. China is a collectivist society emphasizing parent-child relationships, considering them more important than other relationships; therefore, compared to individualistic societies, parental behavior in Chinese society is more likely to influence the psychology and behavior of adolescents. Future research can explore cross-cultural differences in the effects of parental psychological control on smartphone use, especially considering how this behavior might differ across countries.

Conclusions

This research examines how psychological reactance and psychological resilience mediate and moderate the relationship between parental psychological control and problematic smartphone use. The findings show that psychological reactance partially mediates this relationship, while psychological resilience partially moderates it. The study provides valuable insights into the risks associated with problematic smartphone use, particularly in the Chinese context. The results suggest that adolescents under high parental psychological control may exhibit increased psychological reactance, leading to problematic smartphone use. Additionally, psychological resilience can mitigate the effects of parental psychological control on problematic smartphone use, offering protection to adolescents in such situations.

List of abbreviations.

In the order of the sequence presented in the text:

PPC: parental psychological control.

SDT: self-determination theory.

PRt: psychological reactance.

PRl: psychological resilience.

PSU: problematic smartphone use.

Author contributions
Q.L. and Z.L contributed to conceptualization, investigation, writing-original draft and writing review & editing. Z.L performed the supervision and funding

acquisition. Q.L was in charge of the methodology and formal analysis. Z.L contributed to writing review & editing. All authors read and approved the final manuscript.

Data availability
The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Shanghai University (protocol code ECSHU 2024-021 and Apr.16th,2024 of approval). Informed consent was obtained from participants.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

References
1. Billieux J. Problematic use of the Mobile phone: a Literature Review and a pathways Model. Curr Psychiatry Reviews. 2012;8(4):299–307. https://doi.org/10.2174/157340012803520522.
2. Busch PA, McCarthy S. Antecedents and consequences of problematic smartphone use: a systematic literature review of an emerging research area. Comput Hum Behav. 2021;114:1–47. https://doi.org/10.1016/j.chb.2020.106414.
3. Panova T, Carbonell X. Is smartphone addiction really an addiction? J Behav Addictions. 2018;7(2):252–9. https://doi.org/10.1556/2006.7.2018.49.
4. Ruihan C, Zhitong Z, Zhiyan C, Hongge L. Similarities and differences in core symptoms of problematic smartphone use among Chinese students enrolled in grades 4 to 9: a large national cross-sectional study. Addict Behav. 2025;160:1–19. https://doi.org/10.1016/j.addbeh.2024.108164.
5. Cheng J, Peng C, Rong F, Wang Y, Tan Y, Yu Y. Mobile phone addiction and suicide behaviors among Chinese adolescents: the mediation of poor sleep quality. J Behav Addictions. 2024;13(1):88–101. https://doi.org/10.1556/2006.2023.00078.
6. Kwon M, Kim D-J, Cho H, Yang S. The Smartphone Addiction Scale: Development and Validation of a short version for adolescents. PLoS ONE. 2014;8(12):1–7. https://doi.org/10.1371/journal.pone.0083558.
7. Yıldırım M, Çiçek İ, Öztekin GG, Aziz IA, Hu J. Associations between Problematic Social Media Use and Psychological Adjustment in Turkish adolescents: mediating roles of Family relationships. Int J Mental Health Addict 2023:1–19. https://doi.org/10.1007/s11469-023-01138-3
8. Yıldırım M. İ Çiçek 2022 Fear of COVID-19 and Smartphone Addiction among Turkish adolescents: Mitigating Role of Resilience. Family J 1–8 https://doi.org/10.1177/10664807221139510.
9. Bai Q, Bai S, Huang Y, Hsueh F-H, Wang P. Family incivility and cyberbullying in adolescence: a moderated mediation model. Comput Hum Behav. 2020;110:1–8. https://doi.org/10.1016/j.chb.2020.106315.
10. Wartberg L, Kriston L, Thomasius R. Internet gaming disorder and problematic social media use in a representative sample of German adolescents: prevalence estimates, comorbid depressive symptoms and related psychosocial aspects. Comput Hum Behav. 2020;103:31–6. https://doi.org/10.1016/j.chb.2019.09.014.
11. Jimeno MV, Ricarte JJ, Toledano A, Mangialavori S, Cacioppo M, Ros L. Role of attachment and family functioning in problematic smartphone use in young adults. J Fam Issues. 2021;43(2):375–91. https://doi.org/10.1177/0192513X21993881.
12. Nielsen P, Favez N, Rigter H. Parental and family factors Associated with problematic gaming and problematic internet use in adolescents: a systematic literature review. Curr Addict Rep. 2020;7(3):365–86. https://doi.org/10.1007/s40429-020-00320-0.
13. Yun J, Han G, Son H. Protective and risk factors of problematic smartphone use in preteens using panel study on Korean children. Front Psychiatry. 2022;13:1–8. https://doi.org/10.3389/fpsyt.2022.981357.
14. Lee EJ, Ogbolu Y. Does parental control Work with Smartphone Addiction? A cross-sectional study of children in South Korea. J Addictions Nurs. 2018;29(2):128–38. https://doi.org/10.1097/JAN.0000000000000222.
15. Sun R, Gao Q, Xiang Y. Perceived parental monitoring of smartphones and problematic smartphone use in adolescents: mediating roles of self-efficacy and self-control. Cyberpsychology Behav Social Netw. 2022;25(12):784–92. https://doi.org/10.1089/cyber.2022.0040.
16. Barber BK. Parental psychological control: revisiting a neglected construct. Child Dev. 1996;67(6):3296–319. https://doi.org/10.1111/j.1467-8624.1996.tb01915.x.
17. Ng FF-Y, Pomerantz EM, Deng C. Why are Chinese mothers more Controlling Than American Mothers? My child is my Report Card. Child Dev. 2014;85(1):355–69. https://doi.org/10.1111/cdev.12102.
18. Romm KF, Metzger A. Parental psychological control and adolescent problem behaviors: the role of depressive symptoms. J Child Fam stud. 2018;27(7):2206–16. https://doi.org/10.1007/s10826-018-1064-x.
19. Liu ZY, Wang SZ, Zhao XH. Relationship between parental psychological control and problematic smartphone use among College students in China during and after the COVID-19 pandemic: a mediation analysis. Sustainability. 2023;15(17):1–9. https://doi.org/10.3390/su151712967.
20. Deci EL, Ryan RM. Facilitating optimal motivation and psychological well-being across life's domains. Can Psychol / Psychologie Canadienne. 2008;49(1):14–23. https://doi.org/10.1037/0708-5591.49.1.14.
21. Scharf M, Goldner L. If you really love me, you will do/be… parental psychological control and its implications for children's adjustment. Dev Rev. 2018;49:16–30. https://doi.org/10.1016/j.dr.2018.07.002.
22. Brehm JW. Control, Its Loss, and Psychological Reactance. In: *Control Motivation and Social Cognition*. edn. Edited by Weary G, Gleicher F, Marsh KL. New York, NY: Springer New York; 1993: 3–30.
23. Herrman H, Stewart DE, Diaz-Granados N, Berger EL, Jackson B, Yuen T. What is Resilience? Can J Psychiatry. 2011;56(5):258–65. https://doi.org/10.1177/070674371105600504.
24. Roisman GI, Newman DA, Fraley RC, Haltigan JD, Groh AM, Haydon KC. Distinguishing differential susceptibility from diathesis–stress: recommendations for evaluating interaction effects. Dev Psychopathol. 2012;24(2):389–409. https://doi.org/10.1017/S0954579412000065.
25. Parsons S, Kruijt A-W, Fox E. A cognitive model of psychological resilience. J Experimental Psychopathol. 2016;7(3):296–310. https://doi.org/10.5127/jep.053415.
26. Li Q, Wei S, Liu Z. How is parental psychological control associated with adolescent mental health in economically disadvantaged areas? The serial mediating role of psychological reactance and problematic smartphone use. Front Psychiatry. 2024;15:1–10. https://doi.org/10.3389/fpsyt.2024.1458378.
27. Çiçek İ, Tanriverđi S, Şanli M, Buluş M. Parental attitudes and socio-demographic factors as predictors of Smartphone Addiction in University students. Int J Psychol Educational Stud. 2021;8:158–69. https://doi.org/10.52380/ijpes.2021.8.2.430.
28. Cetinkaya L. The relationship between perceived parental control and internet addiction: a cross-sectional study among adolescents. Contemp Educational Technol. 2019;10(1):55–74. https://doi.org/10.30935/cet.512531.
29. Yogesh M, Ladani H, Parmar D. Associations between smartphone addiction, parenting styles, and mental well-being among adolescents aged 15–19 years in Gujarat, India. BMC Public Health. 2024;24(1):1–11. https://doi.org/10.1186/s12889-024-19991-9.
30. Rosenberg BD, Siegel JT. Threatening uncertainty and psychological reactance: are freedom threats always noxious? Curr Psychol. 2023;42(5):3968–77. https://doi.org/10.1007/s12144-021-01640-8.
31. Laird RD, Frazer AL. Psychological reactance and negative emotional reactions in the link between psychological control and adolescent adjustment. Soc Dev. 2020;29(1):159–77. https://doi.org/10.1111/sode.12407.
32. Ma A, Tang S, Kay AC. Psychological reactance as a function of thought versus behavioral control. J Exp Soc Psychol. 2019;84:1–13. https://doi.org/10.1016/j.jesp.2019.103825.
33. Haider SA, Zubair M, Tehseen S, Iqbal S, Sohail M. How does ambidextrous leadership promote innovation in project-based construction companies?

Through mediating role of knowledge-sharing and moderating role of innovativeness. Eur J Innov Manage. 2023;26(1):99–118. https://doi.org/10.1108/EJIM-02-2021-0083.

34. Sohail M, Chaudhary A, Rehman. Stress and health at the Workplace-A review of the literature. J Bus Stud Q. 2015;6(3):94–121.
35. Meeus A, Eggermont S, Beullens K. Constantly connected: the role of parental mediation styles and self-regulation in pre- and early adolescents' problematic mobile device use. Hum Commun Res. 2019;45(2):119–47. https://doi.org/10.1093/hcr/hqy015.
36. Yang X, Zhang L. Reducing parent-adolescent conflicts about mobile phone use: the role of parenting styles. Mob Media Communication. 2021;9(3):563–83. https://doi.org/10.1177/2050157920986190.
37. Moreira PAS, Inman RA, Cloninger CR. Reactance and personality: assessing psychological reactance using a biopsychosocial and person-centered approach. Curr Psychol. 2022;41(11):7666–80. https://doi.org/10.1007/s12144-020-01310-1.
38. Servidio R. Self-control and problematic smartphone use among Italian University students: the mediating role of the fear of missing out and of smartphone use patterns. Curr Psychol. 2021;40(8):4101–11. https://doi.org/10.1007/s12144-019-00373-z.
39. Troll ES, Friese M, Loschelder DD. How students' self-control and smartphone-use explain their academic performance. Comput Hum Behav. 2021;117:1–10. https://doi.org/10.1016/j.chb.2020.106624.
40. Khan HSud, Zhiqiang M, Siddiqui SH, Khan MAS. Be aware not reactive: testing a mediated-moderation model of Dark Triad and Perceived Victimization via Self-Regulatory Approach. Front Psychol. 2020;11:1–16. https://doi.org/10.3389/fpsyg.2020.02141.
41. Terrill AL, Molton IR, Ehde DM, Amtmann D, Bombardier CH, Smith AE, Jensen MP. Resilience, age, and perceived symptoms in persons with long-term physical disabilities. J Health Psychol. 2014;21(5):640–9. https://doi.org/10.1177/1359105314532973.
42. Yildirim M. Mediating role of Resilience in the relationships between fear of happiness and affect balance, satisfaction with life, and flourishing. Europe's J Psychol. 2019;15(2):183–98. https://doi.org/10.5964/ejop.v15i2.1640.
43. Bussemakers C, Kraaykamp G. Youth adversity, parental resources and educational attainment: contrasting a resilience and a reproduction perspective. Res Social Stratification Mobil. 2020;67:1–11. https://doi.org/10.1016/j.rssm.2020.100505.
44. Tehseen S, Yee KV, Haider SA, Hossain SM, Sohail M. Entrepreneurial competencies, Innovation enablers and sustainable competitive advantage among Micro firms across cultures: a comparative study of Canada and Malaysia. J Industrial Integr Manage. 2024;9(2):195–225. https://doi.org/10.1142/S2424862224500040.
45. Hao Z, Jin L, Huang J, Wu H. Stress, academic burnout, smartphone use types and problematic smartphone use: the moderation effects of resilience. J Psychiatr Res. 2022;150:324–31. https://doi.org/10.1016/j.jpsychires.2022.03.019.
46. Zarotti N, Povah C, Simpson J. Mindfulness mediates the relationship between cognitive reappraisal and resilience in higher education students. Pers Indiv Differ. 2020;156:1–5. https://doi.org/10.1016/j.paid.2019.109795.
47. Wang Q, Pomerantz EM, Chen H. The role of parents' control in early adolescents' psychological functioning: a longitudinal investigation in the United States and China. Child Dev. 2007;78(5):1592–610. https://doi.org/10.1111/j.1467-8624.2007.01085.x.
48. Kwon M, Kim D-J, Cho H, Yang S. The Smartphone Addiction Scale: Development and Validation of a short version for adolescents. PLoS ONE. 2014;8(12):e83558. https://doi.org/10.1371/journal.pone.0083558.
49. Zhuang H, Liu R, Liu Y. The impact of peer attachment on problematic mobile phone use among adolescents:Moderated Mediation Effect of Loneliness and Self-Construal. J Psychol Sci. 2017;40(1):89–95. https://doi.org/10.16719/j.cnki.1671-6981.20170114.
50. Hong S-M, Faedda S. Refinement of the Hong Psychological Reactance Scale. Educ Psychol Meas. 1996;56(1):173–82. https://doi.org/10.1177/0013164496056001014.
51. Fan M, Gu C, Wang H, Xue Y. The relationship between lower secondary school students' psychological reactance and parenting styles: the mediating effect of personality. Chin J Special Educ. 2016;5:69–74.
52. Hu Y-Q, Gan Y-Q. Development and psychometric validity of the resilience scale for Chinese adolescents. Acta Physiol Sinica. 2008;40(8):902–12. https://doi.org/10.3724/SP.J.1041.2008.00902.
53. Zhao Y, Zhang X, Du J, Zheng X. Relationship between social support and depression, loneliness of migrant children: Resilience as a moderator and mediator. Chin J Clin Psychol. 2014;22(3):512–21. https://doi.org/10.16128/j.cnki.1005-3611.2014.03.077.
54. Podsakoff PM, MacKenzie SB, Lee J-Y, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. J Appl Psychol. 2003;88(5):879–903. https://doi.org/10.1037/0021-9010.88.5.879.
55. Newman DA. Missing data: five practical guidelines. Organizational Res Methods. 2014;17(4):372–411. https://doi.org/10.1177/1094428114548590.
56. Hancock GR, Mueller RO, Stapleton LM. The reviewer's guide to quantitative methods in the social sciences. Routledge; 2010.
57. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav Res Methods. 2008;40(3):879–91. https://doi.org/10.3758/BRM.40.3.879.
58. He Y, Yuan K, Sun L, Bian Y. A cross-lagged model of the link between parental psychological control and adolescent aggression. J Adolesc. 2019;74:103–12. https://doi.org/10.1016/j.adolescence.2019.05.007.
59. Yan F, Zhang Q, Ran G, Li S, Niu X. Relationship between parental psychological control and problem behaviours in youths: a three-level meta-analysis. Child Youth Serv Rev. 2020;112:1–9. https://doi.org/10.1016/j.childyouth.2020.104900.
60. Steindl C, Jonas E, Sittenthaler S, Traut-Mattausch E, Greenberg J. Understanding psychological reactance: new developments and findings. Z Psychol. 2015;223(4):205–14. https://doi.org/10.1027/2151-2604/a000222.
61. Lewing CA, Caraway SJ. Psychological reactance as a motivation in psychopathy. Pers Indiv Differ. 2019;139:355–9. https://doi.org/10.1016/j.paid.2018.12.007.
62. Çiçek İ. Effect of Hope on Resilience in adolescents: Social Support and Social Connectedness as mediators. J Posit School Psychol. 2021;5:136–47. https://doi.org/10.47602/jpsp.v5i2.283.
63. Çakmak Tolan Ö, Bolluk Uğur G. The relation between psychological resilience and parental attitudes in adolescents: a systematic review. Curr Psychol. 2024;43(9):8048–74. https://doi.org/10.1007/s12144-023-04966-7.
64. Ran L, Wang W, Ai M, Kong Y, Chen J, Kuang L. Psychological resilience, depression, anxiety, and somatization symptoms in response to COVID-19: a study of the general population in China at the peak of its epidemic. Soc Sci Med. 2020;262:113261. https://doi.org/10.1016/j.socscimed.2020.113261.
65. Hong F, Tarullo AR, Mercurio AE, Liu S, Cai Q, Malley-Morrison K. Childhood maltreatment and perceived stress in young adults: the role of emotion regulation strategies, self-efficacy, and resilience. Child Abuse Negl. 2018;86:136–46. https://doi.org/10.1016/j.chiabu.2018.09.014.
66. Shen X. Is psychological resilience a protective factor between motivations and excessive smartphone use? J Pac Rim Psychol. 2020;14:1–8. https://doi.org/10.1017/prp.2020.10.
67. Kasser T. Materialistic values and goals. Ann Rev Psychol. 2016;67(67):489–514. https://doi.org/10.1146/annurevpsych-122414-033344.

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